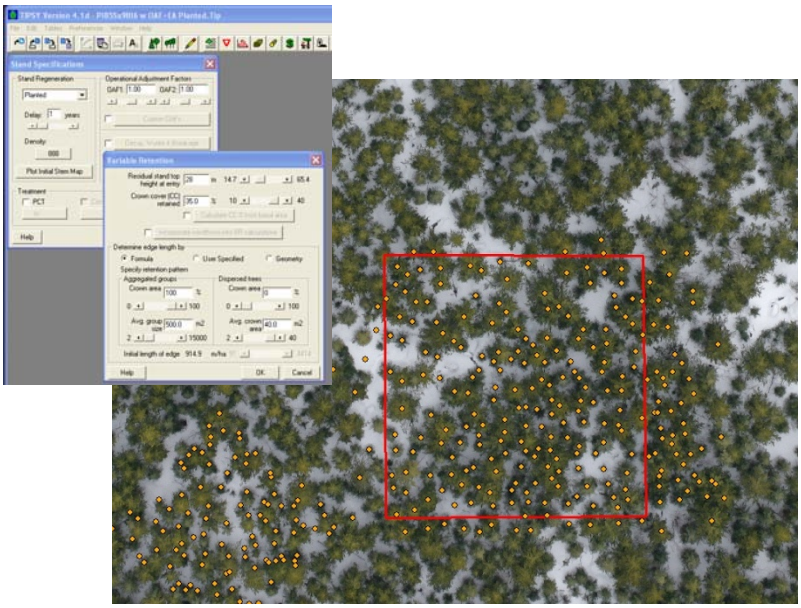
USER'S MANUAL VER. 1.1

For The ML IFPA Multi-Block Stocking Standard

This user's manual describes the Morice-Lakes IFPA multi-block stocking standard and how regeneration performance is evaluated under this standard. It was produced for licensee staff involved in data acquisition, compilation, and/or reporting associated with the multi-block system. Rationale for these procedures is provided elsewhere.



Prepared by LM Forest Resource Solutions Ltd.

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THE STANDARD AND REGULATORY FRAMEWORK

WHAT IS A MULTI-BLOCK STOCKING STANDARD?

Multi-block stocking standards are a way to assess whether a licensee's stocking practices are adequate. An assessment of a population (see definitions below) of cutblocks harvested in one year, is made **13** years after harvest. The entire population of blocks either passes or fails based on whether future yield, predicted from survey data, is similar to future yield, predicted using the stocking assumptions used in timber supply analysis. Yield is predicted using the Ministry of Forest's Tree and Stand Simulator (TASS).

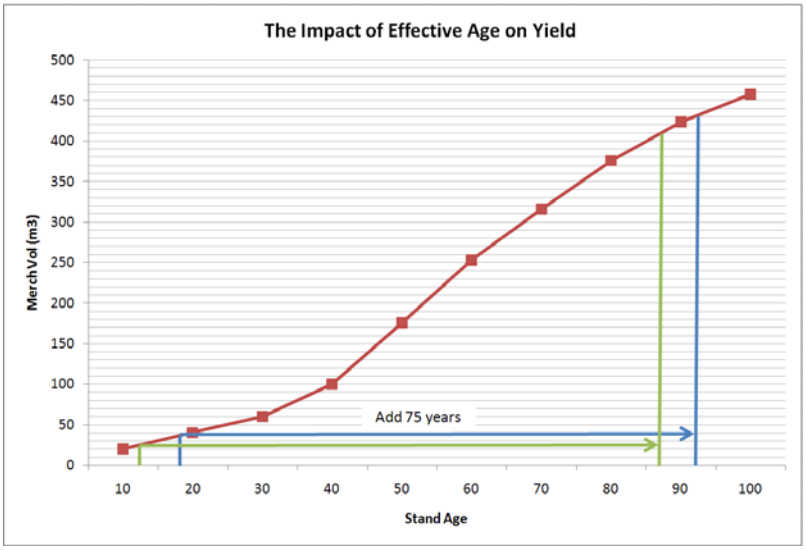
DEFINITIONS

Here are some definitions that you need to know to start using the multi-block approach:

Broadleaf: Deciduous tree species that might be considered acceptable as a crop tree or competition to crop trees.

Competition: Means having more than 5 broadleaf trees in a plot that are taller than the mean height of the co-dominant conifer trees in a plot.

Effective Age: Effective age is the apparent age of a stand based on its height. It is determined by comparing actual height for a particular stand, to height growth curves developed for that species by the Ministry of Forests (see also Appendix II). The apparent age from the height growth curves is used in the following calculation to determine what age to model the stand to: *90 – years since harvest + effective age*. If a stand is taller or shorter than what would be expected, it will be modeled for more or less years depending on its effective age. This approach accounts for the cumulative effects of early stand treatments on growth. An example is shown in the graph below.



In this hypothetical example, two stands were measured 15 years after harvest. The green lines represent a stand whose average height was only equivalent to a 12 year old stand (even though it had been growing for 15 years). The blue lines represent a stand whose average height was equivalent to a 17 year old stand. The stand represented by the green lines is modeled to 90 –15 +12 = 87 years and the stand represented by the blue line is modeled to 90 -15 +17 = 92 years. The red line shows the impact on yield.

***Ecologically Suitable*:** Tree species that will contribute to the PMV for a BEC zone, subzone, variant, and site series based on their ability to grow well on a site with due regard to future climatic conditions.

Pest-Fre: means trees that are free of forest health factors as defined in the *Forest Planning and Practices Regulation* as it is on the date of approval of the multiblock standard.

Population: A population is comprised of a group of cut blocks or standards units within a specified administrative unit (e.g. Forest Development Unit) in which harvesting was completed within the same 12 month period (commencing April 1 and ending March 31) thirteen years earlier.

PMV (Predicted Merchantable Volume): Is the merchantable volume/ha predicted to occur at each plot in the population, using TASS**,** a projected age of 90 years adjusted for Effective Age, and data from each plot on:

(a) total coniferous trees/ha by species that are pest-free, ecologically suitable, free from competition, and a minimum height of 50 cm.
(b) total deciduous trees/ha by species that are pest-free, ecologically suitable, and a minimum height of 100 cm, to a maximum of 600 trees/ha;
(c) site index values observed at each plot for each species.
(d) the average OAF1 operational adjustment factor value for the stratum associated with each plot.
(e) the OAF2 operational adjustment factor for the plot when there are competing Broadleaf trees.
(f) actual regeneration delay achieved.
(g) observed stem distribution (even, random, clumped, even with random, or even with clumped).

TASS: (Tree And Stand Simulator) is a growth and yield model used by the Ministry of Forests and Range for simulating stand volume for Timber Supply Review.

TMV (Target Merchantable Volume): Is the merchantable volume/ha predicted to occur at each plot in the population at age 90 when input assumptions on regeneration that mimic those used in the timber supply analysis available at the time the standard is approved are used in TASS.

Regeneration Assumptions: means the input values used in **TASS** to determine **TMV** at each plot in the survey population including:

(a) an initial stand establishment density of 1500 stems per hectare.
(b) a regeneration delay of 2 years
(c) an OAF1 operational adjustment factor of 15%.
(d) an OAF2 operational adjustment factor of 5%.
(e) a planted stem distribution.
(f) site index values for each species obtained from survey data at each plot.
(g) a species composition at each plot that is based on the leading species at the plot and, for the population of plots, matches the proportions indicated in the table below (for example, with pine, Douglas-fir, larch, or aspen leading plots, 49% of the plots will have a Pl80Sx20 species mix and 51% of plots will have a Pl50Sx50 species mix).

Leading Species	Assigned Composition	%	Assigned Composition	%	Assigned Composition	%
Pl, Fd, Lw, or At	Pl80Sx20	49	Pl50Sx50	51	Sx80Pl20	0
Sx, Sb, Hm, Act	Pl80Sx20	35	Pl50Sx50	55	Sx80Pl20	10
Bl, Ba, or Ep	Pl80Sx20	61	Pl50Sx50	23	Sx80Pl20	16

Stratum: In the multi-block system, a stratum i
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Species·Class¤	Stocking·Class¤	Site·Index·Class¤
>65%·Pl¤	<1000·stems/ha¤	<16¤
>65%·Sx¤	··1000·to·3000¤	16·to·20¤
>65%·Bl¤	>3000·stems/ha¤	>20¤
Mix¤	¤	¤

racteristics into a single category to reduce complexity
nd reporting. Note that a particular stratum can occur

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Forest Planning and Practices regulation as one or
re is only one of each of the following: (a) soil
standard; (d) free growing date; and (e) free growing
ing a free growing stand on the cutblock. For the
lards unit is equivalent to a soil disturbance unit since
stocking standard apply to all cutblocks, and free
tem.

Enabling Legislation

- Sec. 45 of the FPPR allows licensees to propose, in an FSP, stocking standards that would apply to a group of cutblocks.
- Sec. 16(1) states that the FSP must specify the situations or circumstances that determine when the standards will apply.
- Sec. 16(3)(c) indicates that, in a multi-block approach, a regeneration date and stocking standards must be described in the FSP.
- Sec. 16(3)(d) indicates that, in a multi-block approach, a free growing date and stocking standards must be described in the FSP and that it is the chief forester who approves them.

POTENTIAL BENEFITS OF THE MULTI-BLOCK APPROACH

Some of the potential benefits in using a multi-block approach include:

- Flexibility to invest first in those treatments/sites that will yield the greatest return.
- Better alignment of regeneration efforts with habitat and biodiversity objectives.
- A better link between regeneration practices and timber supply objectives.
- Reduced costs.
- Reduced need for arbitrary rules on minimum stocking and stratum size.

SUPPORTING LEGISLATION

Section 5 of the Forest and Range Practices Act (FRPA) requires stocking standards to be developed and included in an FSP and that results or strategies, in relation to objectives set by government for things like timber and wildlife (amongst others), be specified. Section 29 of the Act states that if an area is harvested, a free growing stand must be established in accordance with these standards. Section 45 of the Forest Planning and Practices Regulation (FPPR) allows standards to be developed for "a group of cutblocks" – referred to in this document as the multi-block approach. Section 16(2) of the FPPR states that in specifying a stocking standard, a person may consider the factors set out in section 6 of Schedule 1 (forest health concerns, the ecological suitability of tree species, and the quantity and distribution of trees). Results or strategies that are specified must be verifiable by the MoF and represent an acceptable risk to the public.

With respect to approval, the Minister (or his designate) approves an FSP, but when the FSP contains a multi-block stocking standard, the Chief Forester must first approve the standard. Section 16(3)(d) of the FPPR indicates that if a stocking standard **relating to the free growing date** is for a group of cutblocks, it is the Chief Forester who approves them. Stocking standards **relating to the regeneration date**, whether single or multi-block, are approved by the District Manager (see http://www.for.gov.bc.ca/hfp/silviculture/multi_block/Martin%20060710%20Multi%20bl%20Stock%20Stnds%20FS%20Plans%20MEMO.doc.pdf). Pertinent sections of the FPPR supporting the multi-block approach, including reporting requirements, are summarized in the text boxes below.

Legislated Reporting Requirements

- A licensee may submit a declaration that an area is regenerated or free growing by June 1st for the 12 month period beginning on April 1 of the immediately preceding calendar year (s. 107 of the Act, and 86 and 97 of FPPR).
- Declarations can be made any time after the

THE STANDARD IN THE FSP

Each licensee must develop and submit their own stocking standard for approval in an FSP. An example from a proposed Canfor FSP is provided in the table below.

The ML IFPA Standard for Regeneration Performance

- A population will be considered successfully regenerated if, within 7 years of harvest commencement, ecologically suitable trees have been established on the population of blocks and:
  - (a) no more that 15% of the area of the population contains fewer than 1000 stems per hectare of ecologically suitable trees, and
  - (b) all areas of the population that are greater than 2.0 contiguous ha in size, have at least 500 stems per hectare of ecologically suitable trees.
  - (c) a monoculture of a species that the District manager has identified a forest health factor that poses a significant risk to the survival and growth of that species has not been established on any contiguous area greater than 2.0 ha.
- A population will be considered to be free growing if, within 20 years of harvest commencement, the lower confidence limit of the average PMV/ha for the population, divided by the average TMV/ha for the population is greater than 0.9 (target is 1.0) and:
  - (d) at least 30% of the stems in a particular BEC Variant are comprised of one or more ecologically suitable tree species other than the leading tree species;
  - (e) no more than 30% of the trees in a population are broadleaf species;
  - (f) there are no contiguous areas greater than 2.0 ha in size in which the number of countable conifers per hectare on any site series exceeds 10,000 stems per hectare for stands in which lodgepole pine represents less than 80 percent of total countable stems, or 20,000 stems per hectare for stands in which lodgepole pine represents greater than or equal to 80 percent of countable conifers.

In the Canfor example, regeneration performance is measured at the regeneration stage, within 7 years of harvest commencement, and at the free growing stage, 13 years after harvest completion. At the regeneration stage, a commitment is made to minimum stocking levels and at the free growing stage, a commitment is made to ensure future yield is closely aligned with the timber supply predicted in timber supply analysis. While the standards are different, survey information survey procedures are largely the same. The rest of this manual describes what type of survey data is collected and how it is processed to determine if regeneration performance standards at the regeneration and free growing stages have been

met. Information is also provided on statistical calculations, tracking and reporting. These details are considered to be information that supports the standard, but are not part of the standard itself.

DATA ACQUISTION

Obtaining the data needed to determine PMV is completed in three stages: identification of the sample population, collection of field data, and post-survey stratification of the field data. Each of these stages is discussed below in more detail below.

IDENTIFICATION OF THE SAMPLE POPULATION

Which Blocks are Eligible?

The first step is to check the FSP to determine which geographic areas are included in the multi-block standard. In Canfor's case, for example, the geographic area of interest is the Morice forest development units (FDU). Within this FDU, any block, or standards unit within a block (greater than 2 ha in size) is eligible, if harvesting was completed 13 years before the assessment date. Harvesting could be completed any time within the period April 1st to March 31st, 13 years earlier. Normally a site plan will be available for these blocks and they would be subject to industrial appraisal. Very large blocks (e.g. 500 ha) might be logged over multiple years and, therefore, may be subject to more than one assessment date.

An Example:

- Company X wants to undertake their regeneration performance assessment during the summer field season in 2010.
- 2010 – 13 = 1997
- Start date for inclusion in the population is April 1st, 1997.
- End date for inclusion in the population is Mar. 31st 1998.

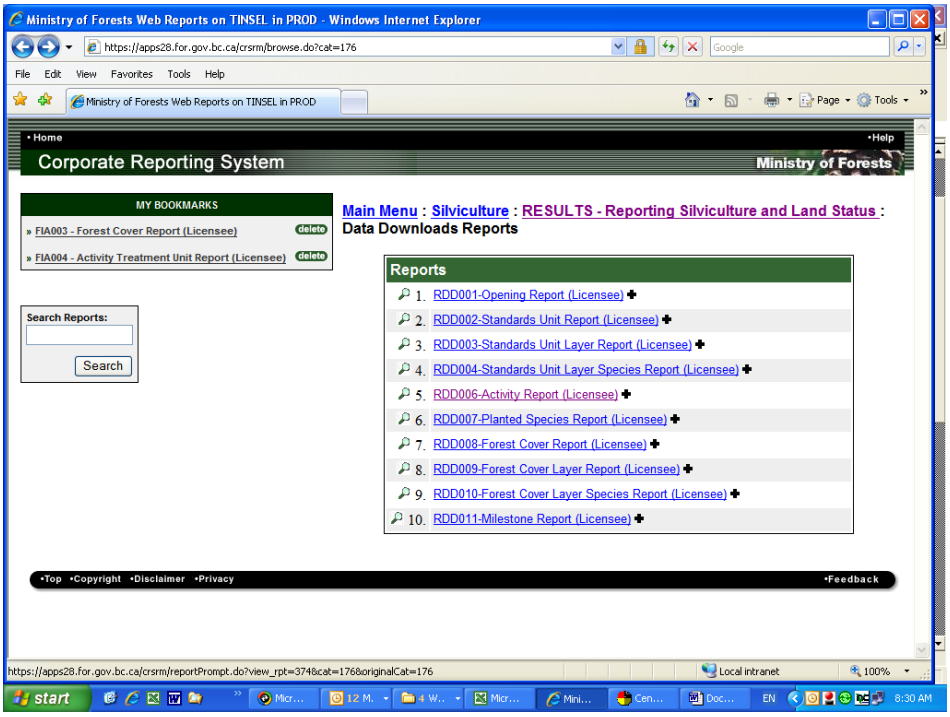
Note that, while the late dates for regeneration and free growing are measured from harvest commencement, timing of the free growing assessment is based on harvest completion.

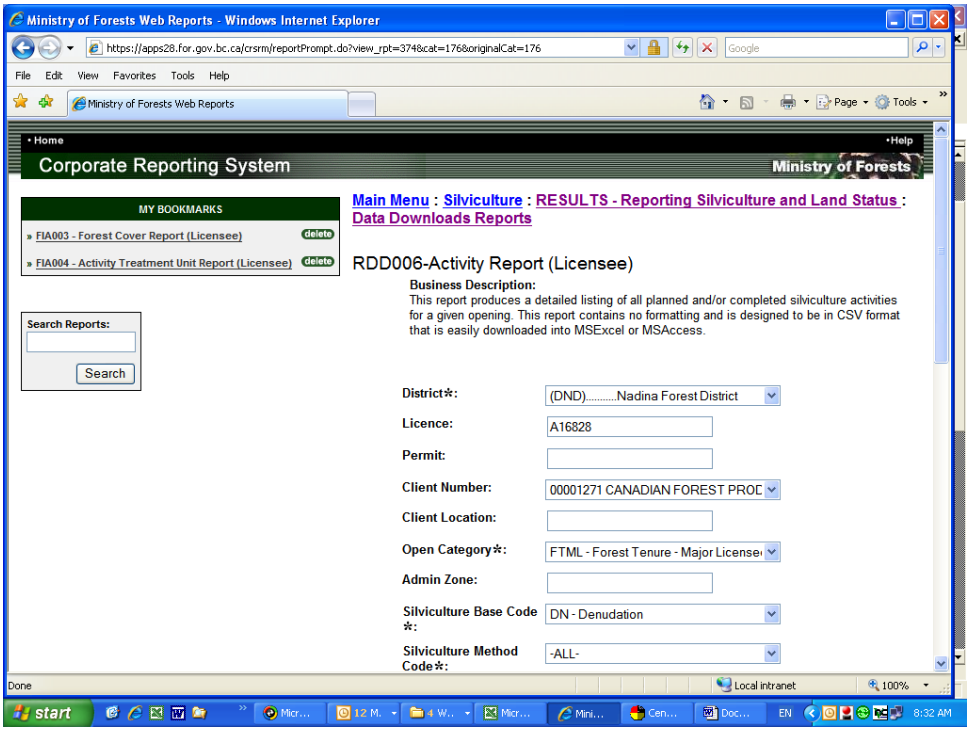
How is the List of Areas Harvested 13 Years Earlier Produced?

Harvest completion will need to be documented (hectares logged and a map) at least annually by the company, regardless of whether the entire block has been completed. With Canfor, for example, a harvest update is completed in Genus twice per year, generally about April 15th and August 15th. Harvest completion will also need to be reported in *Results*[1] on an annual basis (currently the Ministry of Forests is expecting that this will be done by June 1st every year).

To generate the list of blocks to be assessed, an activity report is produced from *Results* for the desired time period (specify that the activity is harvesting, include all company activity, and include all funding sources). The report generated will provide a list of blocks and associated area (ha) by license and permit for the specified dates. It would be best to generate the list in a format that can be imported into Microsoft Excel (csv for example) so that it can be sorted, filtered, and reorganized. An example of the screens used in *Results* to generate such a list is shown below.

[1] Results (Reporting Silviculture Updates and Land status Tracking System) is an on-line electronic submission tool used to track silviculture activities and is part of the Ministry of Forests Electronic Submission Framework (see http://www.for.gov.bc.ca/his/results/index.htm).





In cases where data is missing from the report, it may be necessary to use hard copy records. It is also recommended that the list generated from *Results* be cross checked against internal company records. For example, Canfor could use Crystal Reports to check their Oracle database to ensure that no blocks are missed, or included when they shouldn't have been.

Finally, the list of blocks generated from *Results* will need to be filtered to include only those that fall within the applicable FDUs. The simplest way to do this is to create a GIS spatial layer (e.g. Arc shp file) from one or more of the gml (geographic markup language) coordinates available for each block in *Results* and, using GIS software such as ArcInfo, overlay this with the FDU boundaries to see which blocks are in and which are out.

Example of a UTM Coordinate String for a Cutblock in *Results*.

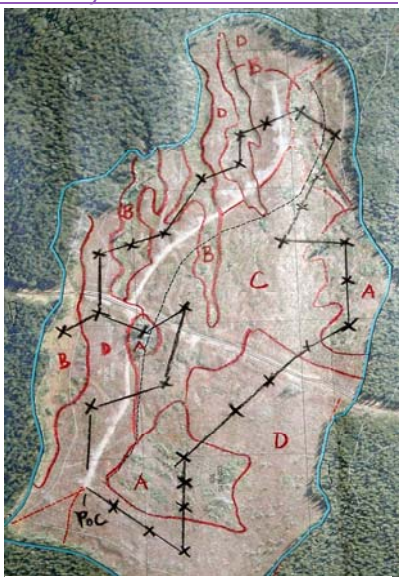
```
<gml:outerBoundaryIs>
- <gml:LinearRing>
    <gml:coordinates>625119.068,5999693.727 625109.875,5999695.0 625100.75,5999696.5 625097.
      625062.091,5999695.69 625059.75,5999703.45 625056.988,5999710.558 625049.35,5999720.
      625080.054,5999726.857 625091.375,5999726.25 625095.688,5999726.5 625104.0,5999726.5
      625118.481,5999703.092 625118.177,5999700.223 625119.068,5999693.727</gml:coordinates>
```

FIELD PROCEDURES

Once a list of eligible areas has been produced and cross checked, a location map, block maps, and photos (optional) will need to be produced and used to design field surveys. There is no specific guidance in the legislation or in government policy regarding the multi-block system, however, survey design and sample intensity must ensure that:

- survey transects cover the area well enough to identify underperforming areas.
- sufficient plots are established to obtain a statistically reliable estimate of key features used to predict future yield.
- plot distribution is such that plots all represent about the same area.
- plot data provides the information needed for yield predictions and management decisions.
- plot information provides the data necessary to define inventory polygons and an inventory label for them.

The recommended survey procedure for the Morice-Lakes multi-block standard is a modified version of the existing silviculture survey methodology (see the 2009 Surveys Procedure Manual at http://www.for.gov.bc.ca/HFP/publications/00099/Surveys/Silviculture%20Survey%20Procedures%20Manual-April%201%202009.pdf). Circular plots are established on a systematic grid or along transects that pass through all potentially different strata in the sample area. When a transect survey is used, it is recommended that air photos be used to pre-stratify the area to be sampled to identify possible differences in site quality and stocking levels (see diagram). Other information including past surveys, site plans, and ecological maps, for example, should also be considered in designing the field survey. Critical elements of the survey procedure are described below.



An example of the transect approach to plot establishment.

Stratification

Three types of stratification are of interest in the multi-block system: standards units, stocking strata, and inventory polygons. The FPPR states that an FSP must specify standards units and the standards that apply to them. As noted above, standards units in the multi-block system are equivalent to soil disturbance units. They do not have a bearing on how the field procedure is performed.

Stocking strata [simply referred to as a strata (plural) or stratum (singular)] are used to identify areas with similar ecological conditions

and stocking levels. Data from field surveys are summarized by stratum and can be used to assist in making management decisions. A stratum can, and often does, occur in more than one block. A surveyor must know how strata are defined. There are 36 different possibilities based on which species is leading, how many stems per hectare there are, and what the site index is (see definitions).

Stratum Example: **>65% Pl - >3000 sph - SI 16 to 20** means a stratum that consists of one or more contiguous areas greater than 1 ha in size that are generally greater than 65% pine and greater than 3000 total conifers/ha, with an average site index of between 16 to 20.

When a surveyor is designing a transect survey, they will use features visible on stereo photos such as aspect, slope, vegetation levels, visible stocking levels, and moisture levels to identify areas that might be different with respect to tree species, stocking, and/or site quality, and then draw lines on the photos around those areas that are relatively uniform. These strata will be used to help determine where to locate plots. When a surveyor is at a particular plot in the field they will need to record which **stratum** the plot falls within on the field card.

After field surveys are complete, the surveyor will finalize stratum boundaries based on plot information and their field maps and photos, and then assign a stratum number to each plot. Individual plots **may** be assigned a stratum number that is different than the conditions observed at the plot if it is logical to do so because the plot falls within a broader area that corresponds to a different stratum number. Strata smaller than one contiguous hectare should be avoided.

Inventory polygons, the third type of stratification, are also delineated after field data is collected. A map must be produced showing inventory polygons in each block and the inventory label associated with them. The rules on polygon delineation in young stands, established by the VRI Resources Inventory Standards Committee, are as follows (see http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri_pip_2k9/vri_pip_%202-5.pdf and http://www.for.gov.bc.ca/dck/lim/RISS_ls_3a_ed_Oct1.pdf, page 31):

- minimum polygon size is 2 ha, except as follows:
  - in areas with indistinct boundaries, it is 5 ha,
  - in non-productive areas, it is 0.25 ha
  - when forest cover inventory information is submitted as part of a free growing declaration, it can be 1 ha because, when a forest cover type crosses an SU boundary, the forest cover polygon is divided into two polygons.
- a new polygon should be delineated if there is:
  - more than a 20% difference in leading species composition (e.g., Pl8Sx2 is separated from Pl5Sx5);
  - a change in the leading species (e.g., Fdc8Cw2 is separated from Cw6Fdc4);
  - a species composition changes from a mixed species to a pure stand (e.g., Fd10 is separated from Fd7Hw2Cw1);
  - an age difference between the leading inventory species in adjacent strata that is 20 years or more;
  - a height difference between the leading inventory species in adjacent strata of 10 m or more;
  - a difference in site index based on the leading inventory species in adjacent strata that is more than 3 m;
  - a different NP type (e.g., NP BR versus NP UNN).
  - a stratum that does not meet the required minimum stocking standard at the regeneration or free-growing late dates;
  - a stratum that has more than the allowable number of countable stems/ha specified in a plan, prescription, or ministry policy;

- a stratum with retained basal area (for example, a clear cut area is adjacent to an area of partial retention)

t Table Values

Inventory polygon delineation does not affect how a multi-block survey is designed but, during the survey, it is necessary to collect the data required to produce an inventory label and polygon boundaries.

Plot Locations

Care must be taken to locate plots in an unbiased way. The systematic grid approach used in conventional silviculture surveys is the best alternative in this respect. The transect approach is biased in that, prior to establishing plots in the field, a surveyor selects representative points on a photo to establish plots. In both cases it is important to avoid biasing plot location in the field. During data collection in the field, the surveyor must be careful to establish the plot at the pre-determined survey points using a conventional chain and compass or using GPS coordinates.

Sample Intensity

In the multi-block system the most important input parameter for determining future yield is total acceptable conifers/ha. Once stocking falls below about 1000 stems/ha, yield reductions accelerate. Sufficient plots must be established in each stratum, therefore, **to a maximum of 2 plots/ha**, to satisfy the following decision rules:

- If mean stems/ha – LCL is greater than 1000 stems/ha, then sufficient plots have been established.
- If mean stems/ha is less than 1000 stems/ha, no further plots are required.
- If mean stems/ha is greater than 1000 stems/ha, but the LCL is below 1000 stems/ha, then sufficient plots must be established to obtain a sample intensity within 10% of the mean (when the mean is greater than 1000 stems/ha) or within 100 stems/ha of the mean (when the mean is less than 1000 stems/ha).

LCL for a stratum is determined in the same way it is with conventional silviculture surveys as follows:

1. Calculate the mean total acceptable conifers/ha ($\bar{x}$)
2. Calculate the standard deviation (s), where $s = \sqrt{\frac{\Sigma(x - \bar{x})^2}{(n-1)}}$
3. Calculate the standard error of the mean ($s_{\bar{x}}$), where $s_{\bar{x}} = \frac{s}{\sqrt{n}}$
4. Find the *t* value for p = 0.05, a confidence level of 95%, and n -1 degrees of freedom
5. Multiply *t* by $s_{\bar{x}}$ to get the confidence interval
6. Subtract the confidence interval from the mean to get the LCL.

Plot Data (Conif/Ha)	6200	1200	3000	1200	1200	1400	1600	1400	1000	1200
Number of Plots	10	Number of plots in the example stratum								
Sum	19400	The sum of acceptable conifers per ha for all plots combined								
Mean	1940	The average number of acceptable conifers/ha in a plot								
t value	2.262	*t* based on 10-1 degrees of freedom and a desired confidence level of 95% (p=0.05)								
Std Dev	1600	The standard deviation for number of acceptable conifers per hectare in the 10 plots								
Std Error	506	The standard error = standard deviation divided by the square root of the number of plots								
Confid Inter	1145	*t* value mulitiplied by the standard error (stems/ha)								

	Confidence Level	
	90%	95%
	Probability	
1 Tail	0.05	0.025
2 Tails	0.10	0.05
df	t value	
4	2.1320	2.7760
5	2.0150	2.5710
6	1.9430	2.4470
7	1.8950	2.3650
8	1.8600	2.3060
9	1.8330	2.2620
10	1.8120	2.2280
11	1.7960	2.2010
12	1.7820	2.1790
13	1.7710	2.1600
14	1.7610	2.1450
15	1.7530	2.1310
16	1.7460	2.1200
17	1.7400	2.1100
18	1.7340	2.1010
19	1.7290	2.0930
20	1.7250	2.0860
21	1.7210	2.0800
22	1.7170	2.0740
23	1.7140	2.0690
24	1.7110	2.0640
25	1.7080	2.0600
26	1.7060	2.0560
27	1.7030	2.0520
28	1.7010	2.0480
29	1.6990	2.0450
30	1.6970	2.0420
40	1.6840	2.0210
60	1.6710	2.0000
80	1.6640	1.9900
100	1.6600	1.9840
1000	1.6460	1.9620

If, after completing the calculations, it is determined that insufficient plots have been established to satisfy the decision rules noted above, further plots will need to be established **to a maximum of 2/ha**. To determine the likely number of plots required,

use the formula $(t^2 \times s^2)/(0.1(\bar{x}))^2$ where t is the t value used in the original calculation, s is the standard deviation for the stratum expressed as number of stems/ha, and $\bar{x}$ is the mean stems/ha for the stratum. If the mean is less than 1000 stems/ha, then the denominator in the equation is simply 0.5^2 rather than $0.1(\bar{x})^2$. To get the number of additional plots, subtract the number of plots already established from the number determined with the formula.

Note that, because a stratum can occur in more than one cutblock, it is not possible to determine the level of statistical precision for a stratum until all the cutblocks have been surveyed. In a conventional silviculture survey, a surveyor would complete a statistical analysis before leaving the block so that if more plots were required they could establish them before leaving. To avoid this problem in the multi-block system, it is recommended that more plots be established in small, variable strata the first time they are surveyed. As experience is gained with the multi-block system, it will become evident which strata are most likely to be problematic. If additional plots do need to be established in a particular stratum, after the initial surveys are completed, they should be distributed randomly in the cutblocks within the largest contiguous examples of the stratum.

Plot Data

At each plot center, 3.99m circular plots are established. Information can be recorded on conventional silviculture survey cards (FS 657, 658, and 659) using extra lines to record non-conventional information such as whether there is an OAF1 gap and information on stem distribution. In the future, it is likely that a redesigned card will be used. Hand held PDAs can also be used although it will be necessary to modify input screens to record the non-conventional information. Data requirements at each plot are summarized in the text box to the right. Note that information on well spaced and free growing stems is not required. It may be useful, however, to collect well spaced information if you are planning on comparing the actual number of well spaced stems/ha observed in the field with the number of well spaced stems predicted in TASS during the compilation process.

Required Plot Data

- number of trees by species
- number of countable trees by species including countable deciduous
- number of competing deciduous
- site series or other measure of site productivity (if site series is not used a site index value for each species is required)
- number of trees that do not meet the free growing damage criteria because of pests
- whether there is an OAF1 gap
- inventory height for the first five species
- inventory age for the first five species
- crown closure (for the inventory label)
- information on stem distribution (even, natural, even with clumped, etc.)
- block, stratum, and plot identifiers
- brush conditions (optional)

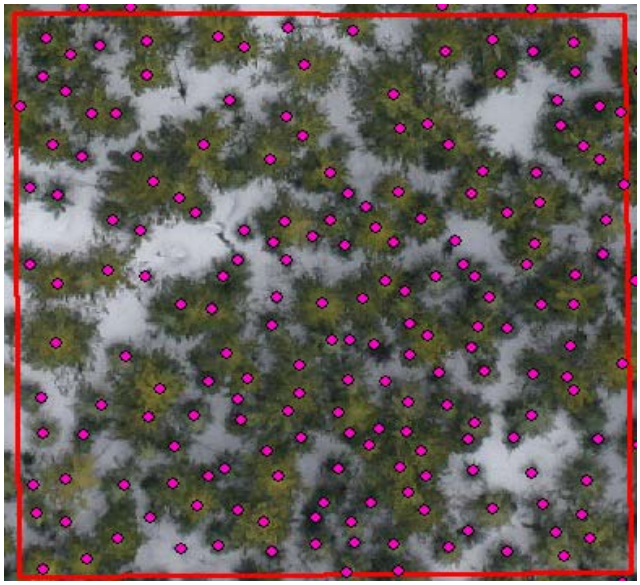
Information on site productivity can be obtained from growth intercepts or SIBEC correlations. If surveyors are qualified to identify site series in seral stands, the SIBEC correlation approach is preferred. Record the relative proportions for each site series in strata with mixed condition (e.g. SBSmc2/$01_8 05_2$). If SIBEC is not used, a growth intercept value will need to be obtained for each of the three leading conifer species using the procedures described in the Growth Intercept Method for Silviculture Surveys manual available at : http://www.for.gov.bc.ca/hfd/pubs/Docs/Sil/Sil345.htm, or using the quick guides to growth intercepts (one for each species – see http://www.for.gov.bc.ca/isb/forms/lib/FS415A.PDF for an example for pine).

Whether there is an OAF1 stocking gap at each plot is based on whether there is an acceptable conifer within 2.7m of the plot centre (for more information on this subject see: http://www.for.gov.bc.ca/HFP/

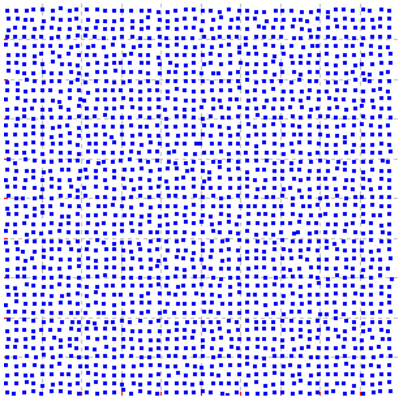
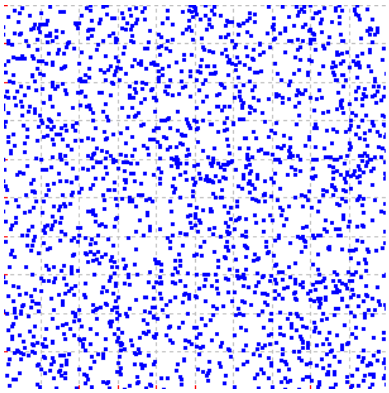
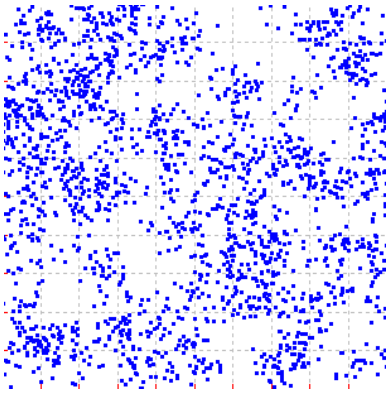
silviculture/OAF1/publications.htm). Acceptable conifer means one that is ecologically suited to the site and which meets the free growing damage criteria available at http://www.for.gov.bc.ca/hfp/silviculture/damage_criteria_2008.pdf. The number of trees by species is collected in the same way it is in conventional silviculture surveys, as is inventory height and age. However, inventory height and age are collected for the three leading species and at every plot (rather than every fourth plot as is the case with conventional surveys).

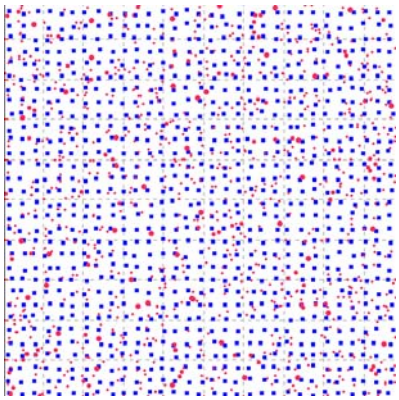
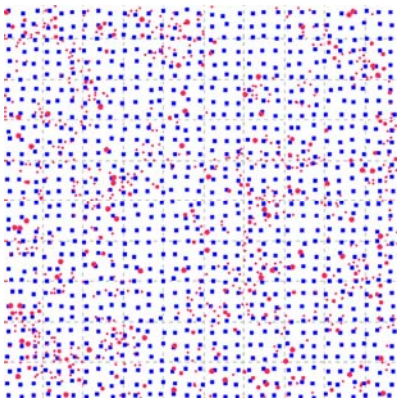
Information On Stem Distribution

Other than the number of well spaced stems/ha, information on stem distribution is not something that is collected in a conventional silviculture survey. In the multi-block approach, however, it is necessary to describe the typical stem distribution in a stratum once the field survey has been completed. This information will be used in TASS to generate a stem map and in the yield simulation (see compilation procedures). While the surveyor is still at the block, they must note on their field form, the pattern of stem distribution in each stratum encountered. There are five options represented below by five different scatter diagrams (in each scattergram there are 2000 stems/ha). During the compilation process, it will be necessary to decide which of these five patterns fits best with the majority of a stratum.



High resolution photo of a stand with an Even-With-Random stem distribution

Even Distribution	Random Distribution	Clumped Distribution
		
• Typical of plantations with little ingress and good survival. • No stocking gaps exist in this example (OAF1 = 0)	• Typical of areas that are regenerated naturally with few or no stocking gaps	• Typical of areas that regenerate naturally and are unevenly stocked. • Some stocking gaps occur

Even Distribution With Random Ingress	Even Distribution With Clumped Ingress
	
• Typical of plantations with substantial, well distributed ingress (in this example there are 1000 surviving planted stems/ha (blue) and 1000 stems of ingress/ha (red)). Different sized circles represent different dates of ingress.	Typical of plantations with substantial, clumpy ingress (again, there are 1000 surviving planted stems/ha (blue) and 1000 stems of ingress/ha (red)). Different sized circles represent different dates of ingress.

For the Even-With-Random distribution and the Even-With-Clumped distribution, the relative proportion of evenly distributed stems versus randomly distributed, or clumped stems, must be recorded for each stratum. For example, 75% of the stems in the stratum in the high resolution photo above are evenly distributed and 25% are randomly distributed. The pattern of stem distribution in that stand would be classified as Even-With-Random ingress.

Mapping

As noted above under stratification, a map must be produced showing inventory polygons in each block and the inventory label associated with them. Data for each inventory polygon will normally be summarized using the MoF form FS810A (http://www.for.gov.bc.ca/isb/forms/lib/FS810A.PDF). Another map should also be produced showing strata boundaries, site series associated with the strata, and any areas that might require treatments like fill planting or brushing. Where treatments are foreseen, a prescription will also be required. The process of mapping and prescribing treatments is essentially the same as that used in conventional silviculture surveys.

COMPILATION PROCEDURES

The next series of steps in the multi-block process involves using the information obtained from field surveys to determine future yield. There are three stages in the compilation process: Data Entry, PMV (predicted merchantable volume) compilation, and TMV (target merchantable volume) compilation. Each of these is described below.

DATA ENTRY

Data Format

Data from the field might be received as hand-written plot cards, in spreadsheet format, or as survey wizard files. Information must be extracted and summarized in a common file format that can be used to produce the information needed for TASS 2.0. The information required for the Ministry of Forests, Research Branch to run TASS 2.0 is relatively simple as can be seen in the text box.[2].

Data Inputs Required in TASS

- Unique identifier for each plot
- Tree species and relative proportions
- Site index for each species (at breast height age 50)
- Number of acceptable trees/ha
- Information on stem distribution
- Regeneration delay
- OAF1 value
- Genetic worth by species (optional)
- Age to project yield to (90 - years since harvest + effective age)

Data summary is completed in a Microsoft Excel (2007) spreadsheet (compiler). The compiler includes four sheets: the Data sheet, Lookup Tables, a Results sheet, and a Sort Data sheet. The Data sheet is used to enter field data and to extract information needed for TASS. The sheet with the Lookup Tables contains all the information supporting the calculations embedded in the Data and Results sheets. The Results sheet summarizes key data for each stratum, populates a table of TASS PMV inputs and a table of TMV inputs, and provides the yield statistics for the population (once information from TASS modeling is entered on the Data sheet). The Sort Data worksheet is used to manipulate data in the "Data" sheet that couldn't be manipulated otherwise because the sheet is protected.

Excerpt from the Excel Compiler.

[2] This will likely change when TASS 3.0 becomes available and tree files and tree coordinates are required.

2010 Multi-Block Data Summary

13		TASS PMV Data		TASS TMV Data		OAF2 Adjustment Factor		
2009		Click this cell to extract		Click this cell to extract		Pine	Other	
		TASS PMV Data		TASS TMV Data		0.7	0.8	
		(see "Results Sheet")		(see "Results Sheet")				

See the User's Manual for comprehensive instructions for this compiler.
The first 15 records of data have been provided as an example. This information must be replaced with actual data when the compiler is used for operational purposes.
White letters in headings indicate fields to be completed from plot data, red headings indicate calculated fields, green headings indicate a field that is completed based o
Do not fill blank cells under a heading with black fill (e.g. Final_Stratum) with zeros or text. Blank cells are used in certain formulae to denote a particular condition and fill
The process for generating unique random numbers (column heading "Random_#)) must be completed after data entry in three steps as follows: 1. copy the entire "Data" s
All cells for which there is a calculation are locked and protected. To unprotect the sheet to make changes, click format/unprotect sheet/ and enter the password.
The TASS PMV Data button and TASS TMV Data button are command buttons that run macros to extract the data needed as input into TASS. When you first open the spread
In the field (column) entitled Tot_Cntbl/Ha, some values are red, some are blue, and most are black. Red and blue values result from conditional formatting and cannot be

Final_Stratum	Stratum_NAR	Seedlot _Spp1	Seedlot _Spp2	Seedlot _Spp3	Planted_or_Nat	Stem_Distrib	Prop_Even	SPH_Even
Sx_<1000_>20	5.0	63121			P	Even	100	800
Sx_<1000_>20	5.0	63121			P	Even	100	600
Sx_<1000_>20	5.0	63121	63155		P	Even	100	800
Sx_<1000_>20	5.0		63121		P	Even Random	50	400
Sx_<1000_>20	5.0	63121			P	Even	100	400
Pl_>3000_16to20	14.5	63155			P	Even Random	35	700
Pl_>3000_16to20	14.5	63155			P	Even Random	40	1760
Pl_>3000_16to20	14.5	63155	63121		P	Even Random	50	1500
Pl_>3000_16to20	14.5	63155	63121		P	Random	0	0
Pl_>3000_16to20	14.5	63155			P	Even Random	35	2170
Mix_1000to3000_16to20	43.1	63155	63121		N	Even Random	40	720
Mix_1000to3000_16to20	43.1	63121	63155		N	Even Clumped	50	700
Mix_1000to3000_16to20	43.1	63121	63155		N	Even Random	45	630
Mix_1000to3000_16to20	43.1	63155		63121	N	Even Random	30	420
Mix_1000to3000_16to20	43.1		63121	63155	N	Even Random	50	1100

Entering Data in the Compiler

Once data collection has been completed and final strata maps have been produced, data is entered into the compiler. **Syntax is important!** Make sure that you pay close attention to spaces, blanks, species codes, and avoid the use of unconventional characters. Try to emulate the example data provided. There is space at the top of the Data sheet for administrative information including who the data entry was done by, when data entry was completed, and a cell for population identification. The population identifier indicates which harvest year and FDUs are included in the population. Below the administrative information there are 117 additional fields, 55 of which are populated with field data, 2 of which are populated using data obtained from TASS, and 60 of which are derived fields based on formulae embedded in the spreadsheet. The spreadsheet is protected so that only the cells in which you are required to enter data can be altered.

The field headers for the spreadsheet are shown below. White letters in the headings indicate fields to be completed from plot data, red letters indicate fields that are automatically calculated, green lettering indicates a field that is completed based on data obtained from TASS, and blue lettering was assigned to a field in which a random number is generated using AbleBits (more on this below).

Field Header	Explanation
Blk_ID	Block Identification
Plot_#	Plot Identification (all numbers in a stratum must be unique)
Final_Stratum	Stratum identification after strata mapping is complete
Stratum_NAR	Net area to reforest in ha for the stratum
Seedlot_Spp1	Primary seedlot for the leading species (e.g. 63121) (*optional*)
Seedlot_Spp2	Primary seedlot for the second most common species (*optional*)
Seedlot_Spp3	Primary seedlot for the third most common species (*optional*)
Planted_or_Nat	Whether the plot is comprised of primarily planted trees (P) or naturals (N)
Stem_Distrib	Even (E), Random (R), Clumped (C), Even w/Random (ER), Even w/Clumped (EC)
Prop_Even	For E, ER and EC distributions, the % countable trees that are **evenly** distributed

SPH_Even	The number of countable stems/ha that are randomly distributed
Prop_Random	For R and ER, the % countable trees that are **randomly** distributed (%)
SPH_Random	The number of countable stems/ha that are randomly distributed
Prop_Clumped	For C, EC and EC distributions, the % countable trees with clumped distribution
SPH_Clumped	The number of countable stems/ha with clumped distribution
Plot_Multiplier	The number the plot area must be multiplied by to obtain values/ha
Spp1	MoF code (e.g. Pl) for Spp1 (Spp2, Spp3, Spp4, Spp5)
Spp1_Tot/Plot	Total Spp1 (Spp2, Spp3, Spp4, Spp5) stems in the plot
Spp1_Cntabl/Plot	Countable Spp1 (Spp2, Spp3, Spp4, Spp5) stems in the plot (if > min ht and pest-free)
Spp1_Prop_Of_Cntbl	Proportion of countable stems/ha represented by Spp1 (Spp2, Spp3, Spp4, Spp5)
Competg_Decid/Plot	Number of stems in the plot that are taller than the mean height of codom conifers
Competg_Decid/Ha	Number of stems/ha that are taller than the mean height of codom conifers
WS/Plot	Number of well spaced trees observed in the plot (*optional*)
Well_Spcd/Ha	Well spaced trees/ha – (*optional*)
Pest_Spp1_Code	The MoF provincial code for pests from the free growing damage criteria
Pest_Spp1/Plot	Number of trees in the plot unacceptably affected by pest Spp1 (Spp2, Spp3)
Pests_Spp1/Ha	Number of trees/ha unacceptably affected by pest Spp1 (Spp2, Spp3)
Tot_Trees/Ha	Total trees per hectare (both acceptable and unacceptable)
Tot_Cntbl/Ha	Total countable trees/ha (if > min ht and pest-free)
Tot_Conif/Ha	Total conifer trees/ha
Tot_Cntbl_Conif/Ha	Total conifer trees/ha that are ecologically suitable, > min height, and pest-free.
Tot_Decid/Ha	Total deciduous trees/ha
Tot_Cntbl_Decid/Ha	Total countable deciduous trees/ha (if > min ht and pest-free). Max = 600/ha
Crwn_Clos	Crown closure at the plot (%) used in the inventory label
Invent_Spp_Lbl	Species proportions observed in the plot (all tree species)
TASS_Spp_Lbl	Species proportions for countable trees only (for use in TASS)
Full_Inv_Lbl	The inventory label for the plot including species, age, height, site index, and stocking
Spp1_Ht	Average height of dominant and co-dominant trees, Spp1 (Spp2, Spp3, Spp4, Spp5)
Spp1_Age	Average total age of dominant and co-dominant trees, Spp1 (Spp2, Spp3, Spp4, Spp5)
Spp1_Ht_Concant	Spp1 (Spp2, Spp3, Spp4, Spp5) and height (in metres) together (e.g. Sx-2.3)
Spp1_Effect_Age_Cntbl	The effective age of countable stems for Spp1 (Spp2, Spp3, Spp4, Spp5)
Wtd_Avg_EA	Weighted average effective age, weighted by stems/ha
Harvest_Age	Age to which the plot will be modeled (90-13+effective age)
BEC_Unit	Biogeoclimatic Zone, Subzone, and Variant (e.g. SBSmc2)
Site_Series1	Most abundant site series (two numerals – e.g. 01)
SS1_%	Percent area in site series 1 (e.g. 75)
Site_Series2	Second most abundant site series
SS2_%	Percent area in site series 2
Site_Series3	Third most abundant site series
SS3_%	Percent area of all other site series combined
SI_Spp1	Site index Spp1 (2,3,4, 5) based on growth intercept or from site series (lookup table)
Wtd_Avg_SI	Weighted average site index of countable stems weighted by number stems
OAF1_Gap_SS	Whether there is an OAF1 gap (1 = no, 2 = yes)
OAF1_Value	Stocking gap as a proportion of area in the plot (%) (from lookup tables)
Decid_Adjustm	The adjustment factor used to reduce yield in a plot if there are competing deciduous
Genetic_Gain_Spp1	The genetic gain (growth) for the seedlot for Spp1 (2,3,4,5) as a percent (lookup tables)
TASS_PMV_Unadj	The merch vol predicted in TASS using data from the plot before OAF1 or 2 adjustmnts
PMV_Adj_for_OAF1	PMV (m^3/ha) after subtracting any applicable OAF1 adjustment (m^3/ha) for stocking gaps
PMV_Adj_for_Decid_Comp	PMV (m^3/ha) after subtracting any applicable adjustment (m^3/ha) for deciduous competition
PMV_Adj_for_OAF1&Decid	PMV (m^3/ha) after subtracting adjustments for OAF1 and deciduous competition
Random #	A random number generated by Ablebits to allocate TSR species mix
TSR Spp Mix	The species mix assigned to the plot based on TSR assumptions needed for the TMV calc
TSR_Spp1	The MoF tree species code for Spp1 (Spp2) used for determining TMV in TASS
TSR_Spp1_Prop	The proportion of stems represented by Spp1 (Spp2)
SI_TSR_Spp1	The site index for Spp1 (Spp20 used in the TMV calculation
TASS TMV	The merchantable volume predicted in TASS using information using the regen assumptions
TASS_TMV_w/OAF1_Adj	TMV (m^3/ha) after subtracting any applicable OAF1 adjustment (m^3/ha) for stocking gaps

There are several important points that you should be aware of when entering data in the compiler:

- The compiler provided with the User's Manual includes hypothetical data for 15 plots provided to demonstrate how data is supposed to be entered. This information must be deleted once you are satisfied that you are entering the actual field data correctly.
- Plots can be entered in any order because you will sort the information later, however, to make it easier to spot data entry errors, it is advisable to complete your data entry by block, stratum, and plot number. You may also wish to add a unique identifier field that can be populated with a simple identifier for each plot such as 1,2,3, etc.
- In the cell adjacent to "Years Since Harvest" enter the number of years that have passed since the cutblocks in the population were harvested. Normally this will be 13 for every block.
- In fields with a heading with grey fill (e.g. Seedlot_Spp1), do not fill blank cells with zeros or text when no other value has been entered. Blank cells are used in certain formulae to denote a particular condition and filling them will change this condition.
- The information under Final_Stratum (e.g. Sx_<1000_>20) should be identical for every plot in the stratum. The information under Orig_Stratum, however, may vary from plot to plot because an individual plot may not conform exactly to the stratum. Once, the stratum mapping has been completed though, every plot that geographically falls within a particular stratum will receive the same stratum identifier regardless of individual plot characteristics.
- Determining which seedlots were used at a particular plot requires that a GIS exercise be conducted to produce a seedlot map. The seedlot map will be supplied by the licensee. You must use the map in conjunction with a plot map to identify which seedlots are associated with planted pine and which are associated with planted spruce. Natural stocking will not have a seedlot. Note that a plot might include species that are not planted or, for a single species, both natural and planted stock. Information on the proportion of planted versus natural stocking will be used to assign the correct genetic worth to each species in the plot.

  Example: *The Conifer_Spp_Label for plot L18 is Sx7Pl3. The stratum that this plot falls within was planted with spruce and there was natural pine and spruce ingress. Despite the fact that some of the spruce stocking was natural, a seedlot number (60294 for example) would be entered under Seedlot_Spp1. The cell for Seedlot_Spp2 would be left blank, however, because the pine stocking was all natural. Seedlot_Spp3 would also be left blank because there was no third species.*

- In the column "Planted_or_Nat" you must indicate whether the majority of the stems in the plot are planted or natural.
- The stem distribution at each plot must also be stated. Information on stem distribution must be recorded at each plot using the diagrams provided under "Information on Stem Distribution" above. For the Even-With-Random distribution and the Even-With-Clumped distribution, you will also need to record the relative proportion of evenly distributed stems versus randomly distributed, or clumped stems, at each plot.

  Example: *Plot D15 occurred in a stratum that had been planted with 1500 stems/ha but another 2000 stems of ingress occurred. Some of the planted stock died and the surveyor indicated that 35% of the stems (mostly planted) were evenly distributed and 65% (naturals) had a clumped distribution. Under the heading "Prop_Even" you would enter 35 and under "Prop_Other", you would enter 65.*

- Under the Spp*x*_Cntabl/Plot columns, do not include species that are not ecologically suitable, unacceptably affected by pests, or smaller than the minimum height. Species that are ecologically suitable by site series should be listed in the Forest Stewardship Plan. An example is included in Appendix I of this manual. Not all pest affected trees are unacceptable, only those

that exceed the limits specified in the Free Growing Damage criteria (http://www.for.gov.bc.ca/hfp/silviculture/damage_criteria_2008.pdf). The minimum height criteria in the Canfor example was 50 cm for conifers and 1m for deciduous trees. **It is important to note that no more than 600 ecologically suitable deciduous species can be counted per plot**.

- The field WS/Plot is not used in the multiblock system to determine yield or regeneration success. This field is, therefore, optional. There is an algorithm available in TASS that can be used to predict the number of well spaced stems/ha from total stems and the observed stem distribution. If you want to compare the TASS prediction for well spaced stems/ha to actual well spaced stems/ha as a way to evaluate the degree to which simulated stem distribution mimics actual stem distribution, you would need to fill out this field.
- The compiler was created to accommodate up to five different tree species in each plot. If there are more than five species, the value for total stems/plot, and total countable stems/plot, should includes all acceptable species that haven't already been accounted for in the values for the other species. The species code for species five will be whatever species is most abundant of the remaining species.
- Species heights and ages are averages for dominant and codominant trees in the plot. Where there is more than one layer in a stand, ages and heights for each layer must be recorded.
- Under the BEC unit and site series headings, the standard information is entered. You can record up to three site series, however, because the information is specific to a single plot, it is not expected that this will be a common occurrence. Percent values must add up to 100.
- The heading "OAF1_Gap" is used to indicate, at each plot, whether there is a stocking gap. A gap exists if there is no acceptable tree within 2.7 m of the plot centre. If there is an OAF1 gap enter a 2, otherwise enter a 1. Once this column in the spreadsheet has been completed, the percent empty plots (PEP) for each **stratum** will be determined automatically and an average OAF value will be generated in the Results sheet for the **stratum** based on PEP value, whether the stratum is predominantly planted or natural, the most common leading species, and average site index. This will be reported on the "Results" sheet under the heading "OAF1 Value (%)" and then each plot (in the Data sheet) corresponding to that stratum will be assigned the average value for the stratum.
- The field "Decid_Adjustm" is automatically populated after the user specifies the adjustment levels for "pine" and "other" under the columns entitled "Deciduous Adjustment Factors" at the top of the Data Sheet. Adjustment levels are based on user knowledge of competition impacts from deciduous trees in the geographic area of interest. They represent the amount by which yield will be reduced if there are competing deciduous in a plot. Default values in the compiler are 0.7 for pine and 0.8 for other species representing 30% and 20% reduction in volume respectively.
- The field entitled "Random#" also requires special action after data entry has been completed. The process for generating unique random numbers (column heading "Random_#)) must be completed after data entry in three steps as follows: 1. copy the entire "Data" sheet to the "Sort Data" sheet, 2. sort the data by the column "Spp1", 3. using the Ablebits add-in, assign a unique number to each cell in the column "Random_#. The entire Data sheet must be copied to the Sort Data sheet because the "Data" sheet is protected and cannot be sorted. If you do not have an AbleBits add-in for your version of Excel, you will need to download it from http://www.ablebits.com/. To use the add-in, select all cells under "Random#" for a species and then, using the Simple Values tab, and the Integer feature, assign a **unique** number to each cell in this column such that the numbers generated for each species go from one to the total number of occurrences for that species. The total number of occurrences for the species can be found in the "Lookup Tables" sheet adjacent to the title " Count of Spp1 = [species symbol]". For example, if pine is leading in 7 plots, then you will need to generate random numbers from 1 to 7. Repeat this process for each species. Remember to ensure there is a check mark in AbleBits in the "Unique values" box. Once the random numbers have been assigned, you will need to resort the

information to match the sorting in the "Data" sheet so that you can copy the unique numbers and paste them into the "Random#" column and ensure that the correct random number is assigned to the correct plot.

- Finally, you must copy yield information obtained from Research Branch for each plot to the headings TASS PMV and TASS TMV once the TASS runs have been completed as described below. This will take place after the initial data entry.

PMV COMPILATION

The compiler was produced to automate the generation of data needed to determine whether the regeneration and free growing standards have been met, including the following statistics:

- various adjusted and unadjusted values for PMV and TMV as well as PMV/TMV ratios.
- species proportions by BEC variant in % (based on total countable stems/ha).
- the proportion of trees in the population that are broadleaf (%).
- the proportion of plots with < 1000 countable stems/ha (%).
- the proportion of plots with < 500 countable stems/ha (%).

It also generates, by stratum, an inventory label, total trees, countable trees, countable conifers, heights and ages for species one and two, site index for species one and two, crown closure, OAF value, and PMV.

To produce these statistics you must enter a TMV OAF1 adjustment factor (normally the same as what is used in timber supply analysis in the area) and then clicking the command buttons "TASS PMV Data" and "TASS PMV Data" (see diagram below).

I	J	K	L	M	N	O	P	Q
TASS PMV Data		TASS TMV Data		OAF2 Adjustment Factor			TMV OAF1 Adjustment Factor	
Click this cell to extract		Click this cell to extract		Pine	Other		0.15	
TASS PMV Data		TASS TMV Data		0.7	0.8		(from Timber Supply Review)	
(see "Results Sheet")		(see "Results Sheet")						

This information is then sent to Ken Polsson of the Ministry of Forest's Research Branch to run through TASS 2.0. **The required format for the information to be sent to Research Branch continues to evolve and may require additional processing.** You will need to work in close cooperation with staff at the Ministry of Forests and Range, Research Branch. Data from the "Results" sheet should be copied to a separate spreadsheet and sent with a covering note explaining that the TASS PMV yield simulation should be run with no OAF1 deduction and no regen delay. A note on how stem distribution should be simulated is also required. The stem distribution instructions will normally include the following points:

- Establishment density must result in a density, 13 years after harvest, that matches the data provided for the plot.[3]
- Species mix at establishment must result in a mix, 13 years after harvest, that matches the data provided for the plot.
- When a plot has an Even-With-Random or Even-With-Clumped distribution, the proportion of evenly spaced stems and the proportion of stems that are not evenly spaced, will be applied equally to all species (*example: in a Sx8Pl2 stand with 2000 stems/ha, 75% of which are evenly spaced, and 25% of which are not, there will be 0.8x2000x0.75 = 1200 evenly spaced Sx and 0.2x2000x0.75 = 300 evenly spaced pine, and 0.8x2000x0.25 = 400 randomly spaced Sx and 0.2x2000x0.25 = 100 randomly spaced Pl*).

[3] TASS simulates yield from establishment to a user specified harvest age. When input data is provided for a stand that is already established, TASS must be extrapolated backwards to get conditions at establishment.

- The espacement pattern at establishment for the evenly spaced stems should mimic planting (3m triangular intertree spacing) and the mortality function must ensure that the number of these evenly spaced stems that survive until age 13 matches the plot data (*in the above example that would be 1200+400 = 1600 stems/ha*).
- Stems that are not evenly spaced will be established in a random or clumped pattern, as indicated in the plot information, over a period of five years from establishment to mimic natural ingress.

Once the TASS runs have been received from Research Branch, the yield for each plot, at the specified harvest age, should be copied to the Data spreadsheet in the compiler under the heading TASS PMV. An example of the kind of output produced by TASS (txt file) is shown below. It would be wise to provide Research Branch with specific instructions on what information is required from the output and in what format. Most of the information generated by TASS is not required for the compiler and a unique identifier must be used so that the TASS volume can be correctly matched with a plot. You must be careful to use the correct value, merchantable volume at the specified harvest age, rather than total volume. Typically, once PMV information is received from Research Branch, an Excel Lookup function will be used to match volume to the correct plot.

```
***** TASS v2.07.61WS Run Summary *********  Tue Mar 10 14:24:38 2009
Plot Description:  Mix_1600_15_PMV
                   Mix-> 1600 sph-SI 12 to 17          , PMV
Species: Label: P1 Name: Lodgepole pine       Site Index (@ BHage 50): 1
  Merchantable volume is calculated using minimum DBH: 12.50 cm, top DIB
Species: Label: S1 Name: White spruce         Site Index (@ BHage 50): 1
  Merchantable volume is calculated using minimum DBH: 12.50 cm, top DIB
Species: Label: P2 Name: Lodgepole pine       Site Index (@ BHage 50): 1
  Merchantable volume is calculated using minimum DBH: 12.50 cm, top DIB
Species: Label: S3 Name: White spruce         Site Index (@ BHage 50): 1
  Merchantable volume is calculated using minimum DBH: 12.50 cm, top DIB
Total and merchantable volumes are expressed in units of cubic m .
Heights are in m , diameters are in cm.  Basal and crown areas are in sq
Gross production figures include mortality and thinnings.
Top height: average height of 100 trees/ha   of largest diameter.
Predominant height: average height of 100 tallest trees/ha  .
Plot size: 71.50 m  x  74.19 m  = 0.5305 ha  ; grid size:0.2003 m
OAFs 1&2: 0.970 1.000 (Operational Adjustment Factors)
=========== STAND STATISTICS (per ha  ) ====================== =========

AGE SITE   TREES  CC   VOLUME        MAI       BA    HEIGHT      CA   CW
(yr)  HT          % TOTAL MERCH TOTAL MERCH   OB  TOP  PREDOM
-------------------------------------------------------------------------
 89  19.0   1503  97   269   217  3.03  2.44  38.3  18.3  19.7   6.4  2.
 90  19.1   1485  97   271   219  3.01  2.44  38.3  18.3  19.9   6.5  2.
 91  19.2   1470  97   274   222  3.01  2.44  38.4  18.5  20.1   6.6  2.
 92  19.3   1461  97   277   225  3.01  2.45  38.6  18.6  20.2   6.6  2.
 93  19.4   1457  97   280   228  3.01  2.46  38.8  18.8  20.4   6.6  2.
 94  19.5   1446  97   283   231  3.01  2.46  39.0  18.9  20.6   6.7  2.
 95  19.6   1441  97   285   234  3.00  2.47  39.1  19.1  20.7   6.7  2.
```

It is also important to note that the extraction macro has been set to work to row 2015. **If there are more than 2000 plots in the data set, the macro will need to be reconfigured.**

TMV COMPILATION

TASS TMV input data is also generated by clicking a command button on the Data sheet in the compiler; in this case the TASS TMV Data button. As was the case with PMV data, this information must be copied and sent to Ken Polsson at Research Branch. There is no requirement to describe stem distribution however, because it is assumed in every plot that the stand will be planted with an even distribution. The regeneration delay will be assumed to be 2 years unless the most recent timber supply analysis specifies otherwise.

Once the TASS runs have been produced by Research Branch, the yield for each plot, for the specified harvest age, should be copied to the Data spreadsheet in the compiler under the heading TASS TMV, being careful to use merchantable volume at the specified harvest age and making sure that the TASS output is matched to the plot correctly.

INTERPRETING COMPILER RESULTS

As noted in the section on Standards in the FSP, a population will be considered to be successfully regenerated if, within 7 years of harvest commencement, ecologically suitable trees have been established on the population of blocks and:

(a) no more that 15% of the area of the population contains fewer than 1000 stems per hectare of ecologically suitable trees, and
(b) all areas of the population that are greater than 2.0 contiguous ha in size, have at least 500 stems per hectare of ecologically suitable trees.
(c) a monoculture of a species that the District manager has identified a forest health factor that poses a significant risk to the survival and growth of that species has not been established on any contiguous area greater than 2.0 ha.

Information on low stocking levels can be found in the compiler in the Results sheet in the area under Yield Statistics (see diagram below). These statistics are derived from the column in the Data sheet on Total_Cntbl/Ha. In the example provided in the compiler, 33% of the plots have less than 1000 stems per ha of ecologically suitable species, and 7% have less than 500 stems/ha. If plots represent approximately equal area, this is equivalent to 33% (and 7%) of the net area to reforest in the population. This population would not meet the regeneration standard based on these results.

BL	BM	BN	BO
Proportion of Plots with < 1000 Countable Stems/Ha (%):			**33**
At the regeneration stage, no more than 15% of plots can have fewer than 1000 stems per hectare of ***ecologically suitable*** *trees.*			
Proportion of Plots With < 500 Countable Stems/Ha (%):			**7**
At the regeneration stage, all areas greater than 2.0 contiguous ha in size, should have less than 500 stems per hectare of ***ecologically suitable*** *trees.*			
Number of pine leading plots that have more than 20,000 stems/ha			**0**
Number of plots with more than 10,000 stems/ha that are not pine leading			**0**

The third criterion (c) on susceptible monocultures, is not directly addressed by the compiler and must be assessed during field surveys and reported in the survey summary for each block.

With respect to the free growing standard, a population will be considered to be free growing if, within 20 years of harvest commencement, the lower confidence limit of the average PMV/ha for the population, divided by the average TMV/ha for the population is greater than 0.9 (90%) and:

(a) at least 30% of the stems in a particular BEC Variant are comprised of one or more ecologically suitable tree species other than the leading tree species;
(b) no more than 30% of the trees in a population are broadleaf species;
(c) there are no contiguous areas greater than 2.0 ha in size in which the number of countable conifers per hectare on any site series exceeds 10,000 stems per hectare for stands in which lodgepole pine represents less than 80 percent of total countable stems, or 20,000 stems per hectare for stands in which lodgepole pine represents greater than or equal to 80 percent of countable conifers.

Information on these criteria is also found in the Results sheet (see diagram below). In the Results sheet, under Species Proportions by Variant, the percent of total countable stems represented by each species is listed adjacent to each variant. Conditional formatting has been used to highlight, in red numbers, any species that represents more than 69% of total countable stems in the variant (making it impossible for other species combined to represent more than 30% of the stems). Percent values for each species have also been summarized under the Summary column by variant.

Yield Statistics for the Population

Yield (m3/ha):

Mean PMV Unadjusted	LCL Mean Unadj PMV	PMV w/OAF1 Adjustm	LCL Mean PMV w/OAF1 Adjustm	PMV Adj for Decid Comp	LCL PMV Adj for Decid Comp
396	354	368	330	387	343

Wtd Avg PMV OAF1 Adjustment: 6.3

(see OAF1 Project Report 2, 1998, MoF, Victoria, BC.)

Species Proportions By Variant in % (based on total countable stems/ha):

	Summary	Count of Pl	Prop Pl	Count of Sx	Prop Sx
ESSFmc	**Pl-n/a-Sx-n/a-Bl-n/a-Fd-n/a-Hw-n/a-At-n/a-Ep-n/a-Ac-n/a**	0	n/a	0	n/a
ESSFmv3	**Pl-n/a-Sx-n/a-Bl-n/a-Fd-n/a-Hw-n/a-At-n/a-Ep-n/a-Ac-n/a**	0	n/a	0	n/a
SBSdk	**Pl-82-Sx-10-Bl-6-Fd-0-Hw-0-At-0-Ep-0-Ac-1**	79	82	10	10
SBSmc1	**Pl-n/a-Sx-n/a-Bl-n/a-Fd-n/a-Hw-n/a-At-n/a-Ep-n/a-Ac-n/a**	0	n/a	0	n/a
SBSmc2	**Pl-24-Sx-50-Bl-21-Fd-0-Hw-0-At-3-Ep-2-Ac-0**	14	24	29	50
SBSwk3	**Pl-n/a-Sx-n/a-Bl-n/a-Fd-n/a-Hw-n/a-At-n/a-Ep-n/a-Ac-n/a**	0	n/a	0	n/a

*At least 30% of the stems in a particular BEC Variant must be comprised of one or more **ecologically suitable** tree species other than the leading tree species.*

Proportion of trees in the population that are broadleaf (%): 2.6

*No more than 30% of the trees in a **population** can be **Broadleaf** species.*

Number of pine leading plots that have more than 20,000 stems/ha 0

Number of plots with more than 10,000 stems/ha that are not pine leading 0

Criterion (b), no more than 30% of trees in the population can be broadleaf (deciduous) species, has its own separate line in the Results sheet. The value for this statistic is highlighted with a red border. In the example above, the value was 2.6%. This value was determined by summing the total countable stems/ha from every plot in which there were aspen, birch, or cottonwood and dividing this by total countable trees from all plots.

With respect to the criterion on maximum conifer densities (c), a value was automatically calculated in the compiler and reported below the values for Proportion of Plots with <500 or <1000 Stems/ha. In the example, there were no plots that exceeded maximum density. These values were calculated from total conifer stems. Note that the proportion of plots was not reported but rather, the number of plots. This is because, with this criterion, even a small proportion of plots (e.g. 1%) could result in the population not passing if there is an area, greater than 2 ha in size, with more than the maximum density allowed for conifers. The maximum density statistic in the compiler is only useful in that it warns that there are some plots where maximum density has been exceeded. In the Data sheet, conditional formatting has been used on the Total_Conif/Ha column to highlight these plots. Cells with pine leading and more than 20,000 stems/ha are highlighted with orange fill, and cells with species other than pine and more than 10,000 stems/ha are highlighted with yellow fill.

The last critical criterion used to determine whether a population can be considered to be free growing, is the PMV to TMV ratio. In the Results sheet, immediately under the title "Yield Statistics for the Population", PMV and TMV values with and without OAF1 and deciduous competition adjustments have been provided as well as corresponding ratios (see diagram below). These values are in cubic meters per hectare and represent averages (and, with respect to PMV, their lower confidence limits) for the entire population of plots. The titles for each are meant to be connotative. For example, LCL PMV w/OAF1 Adj/TMV w/OAF1 Adj means the ratio of the lower confidence limit for PMV after adjusting for OAF1 to TMV after adjusting for OAF1. Note that a lower confidence limit is not used for TMV. Lower confidence limit is calculated at the 95% level of probability on volumes reported in the Data sheet after any adjustment.

Yield Statistics for the Population

Yield (m3/ha):

Mean PMV Unadjusted	LCL Mean Unadj PMV	LCL Mean PMV w/OAF1 Adjustm	LCL PMV Adj for OAF1 & Decid	Mean TMV (m3/ha) Unadj	TMV w/OAF1 Adj	LCL PMV w/OAF1 Adj/TMV w/OAF1 Adj	L
396	354	330	321	434	369	89%	

A number of ratios have been provided to allow the use to evaluate how different factors impact achievement of the standard. The recommended ratio to use is LCL PMV Adj for OAF1 & Decid/TMV

w/OAF1 Adj, the ratio of the lower confidence limit for PMV after adjusting for OAF1 and deciduous competition to TMV after adjusting for OAF1.

REMEDIATION

In the event that the PMV for a population does not meet or exceed 90% of TMV, remediation will be required. Normally this will involve planting to increase stocking levels or treatments such as fertilization or brushing to improve growth. The remediation process will include:

- Identification of areas where treatment can be expected to increase yield to the point that the entire population will pass.
- Implementation of a treatment plan.
- Re-surveying treated areas.
- Recalculation of PMV for all strata in accordance with the procedures described below.
- Preparation of a report outlining the remediation efforts undertaken and the results of the recompilation.

How each of these steps is implemented is explained in the following sections.

IDENTIFYING TREATMENT AREAS AND PREPARING A TREATMENT PLAN

As noted under field procedures, it is important that multi-block survey transects cover the area well enough to identify underperforming areas and that plot data provides the information needed for yield predictions and management decisions The original survey data should, therefore, be sufficient to identify areas where treatment could cost-effectively increase yield. A map of treatment units with an associated prescription should be produced in the original survey.

Some points to consider in developing a treatment plan are that:

- Supplementing stocking by planting has an immediate impact on PMV and will likely result in the largest gain, particularly if genetically improved stock is used.
- Brushing can affect PMV in two ways. If competing conifers are removed, it will eliminate the deciduous competition adjustment factor on any treated plots. If improved growth occurs before the next survey, it may also improve effective age. Note that, in TASS 2.0 there is no brushing function because the yield curves were calibrated against trees growing in relatively brush-free conditions.
- Fertilization will also improve effective age and it can be modeled in TASS and can, therefore, contribute to PMV once treatment is complete. Gains, from fertilization applications at a young age, however, are not big and will typically result in less than a 4% increase in PMV.
- When identifying treatment areas, it will likely be most effective to choose larger contiguous areas with similar ecological conditions and stocking levels first.
- Higher site index units will have a higher priority than lower site index units, unless, with respect to planting, brush conditions are such that seedling survival is in doubt.

RESURVEYING TREATED AREAS

After a remediation plan has been implemented, a survey will be required to verify that the treatment was effective and to obtain the data needed to recalculate PMV. Depending on the nature of the treatment, this may vary from a statistically valid survival survey for planted areas, to a reconnaissance survey in a fertilized area to determine what proportion of trees benefited. Guidelines on survey requirements described in previous sections should be followed, bearing in mind that it is not necessary to collect information on well spaced or free growing trees, and that sufficient information is required to rerun PMV. For treatments that do not involve planting, it may be satisfactory to simply obtain information on effective age and number of competing deciduous and use this information in conjunction with the original survey information to obtain TASS input values.

The timing of a resurvey will depend on the type of treatment undertaken as follows:

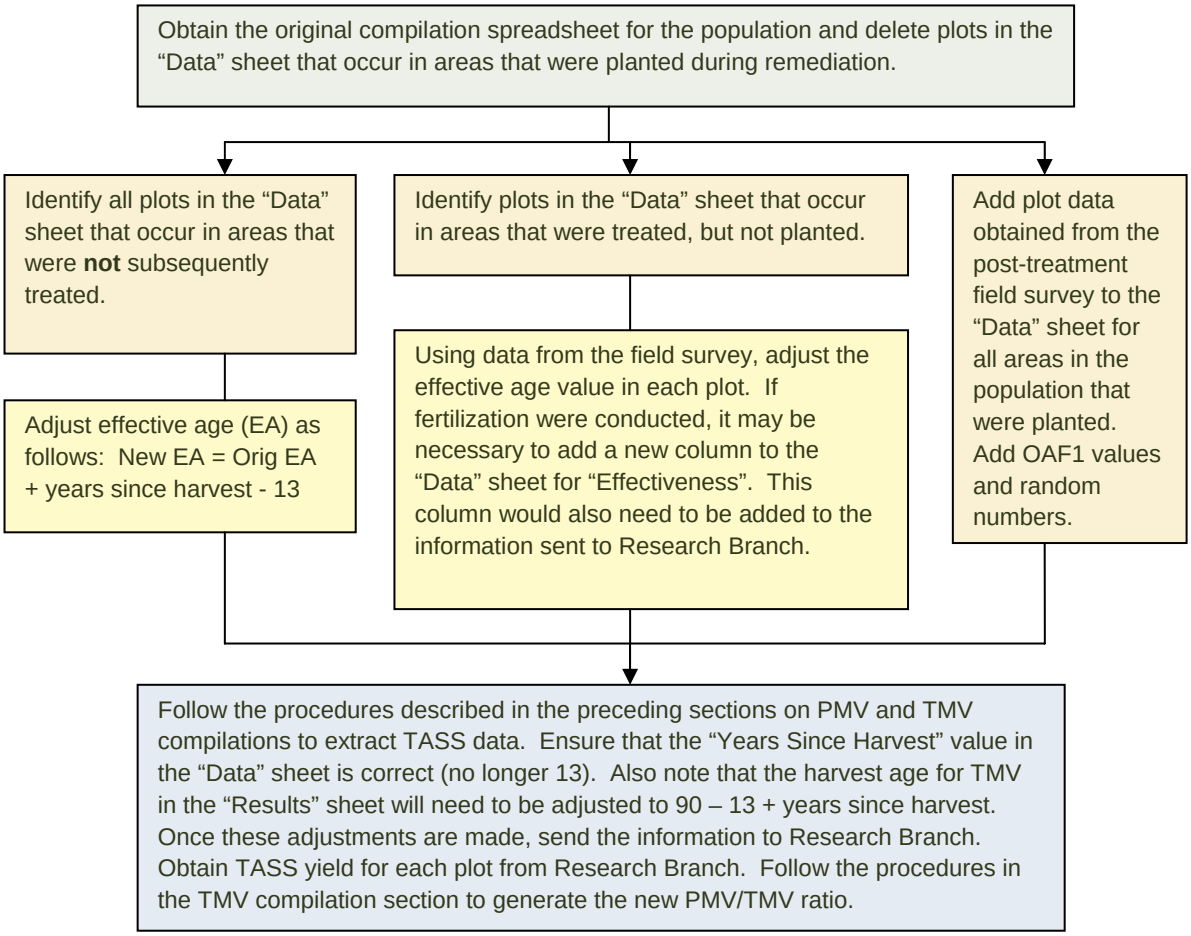
- Planting: sufficiently long after treatment to be sure about seedling survival (1 to 6 years). A later survey may be appropriate if an objective is to obtain a higher effective age.
- Fertilization: 1 to 2 years after treatment, in the fall, when it is apparent what proportion of trees benefited (this is called "effectiveness" in TIPSY and TASS). If it is expected that there will be an improvement in effective age, the area could be surveyed 5 to 7 years after treatment when increased height growth might be apparent.
- Brushing: Improvements in effective age would not normally be apparent until about 5 years after treatment and any gains would be small. The reduction in competing stems at each plot would be immediately apparent after treatment and would have a much bigger impact on yield. With a

conventional stocking standard, a treated area is not eligible for resurvey until two years after treatment.

Once the complete package of treatments in the remediation plan has been implemented, you will need to choose a resurvey date that reflects the time it takes for gains to be made. The limiting factor for resurvey date is, therefore, likely to be whichever treatment takes the longest time for gains to be expressed. **Note that only the areas that were treated will require a resurvey**.

RECALCULATING PMV AND TMV

If a population is assessed 13 years after harvest and it fails to meet the test for regeneration success (i.e. PMV/TMV $\geq$ 90%), a recompilation will be required following remediation to determine whether treatments have improved population yield. The process for doing this has been depicted in the schematic below.



Tips on Recalculating the PMV/TMV ratio:

- Use the Find and Select feature in Excel to identify plots in treated areas and format them (with colour fill for example). These can be deleted if they occur in an area that was planted during remediation. The rest of the plots will require an adjustment for effective age.
- The effective age adjustment can be completed in Excel by copying the effective age columns for each species, pasting the values elsewhere, embedding a formula in the adjacent column to adjust the age, and then pasting the values from this column back into the original column.
- As noted in the schematic, the "Years Since Harvest" cell will need to be changed to reflect how many years after harvest the resurvey occurred. *For example if planting occurred 2 years after the original survey and the planted areas were surveyed two years after that, "Years Since Harvest" would be 13+2+2 = 17*.
- Because the "Results" sheet is protected, a new column will need to be added to the information sent to Research Branch for fertilization effectiveness if fertilization treatments were undertaken and survey data was collected on effectiveness.
- Effective age in plots that were planted and resurveyed will be quite different if the fill plant included different species than were planted originally. If the same species was replanted the surveyor must attempt to estimate the weighted average effective age based on the number of trees from each era of planting.

  *Example: An area that was originally planted with spruce and pine failed and was subsequently replanted with larger spruce stock. A resurvey revealed that the species mix was now Pl6Sx4 and that there were 1600 stems/ha comprised of about 1000 two year old spruce, 0.5m tall, 300 15 year old spruce, 2.9m tall, and 300 15 year old pine, 4.8m tall. The easiest (**but incorrect**) way to get an effective age would be to estimate the average height of each species. In this example, a value for pine of 4.8m would be used and a value for spruce of (0.5+2.9)/2 = 1.7m would be used in the lookup table in the compiler to determine a weighted effective age based on the number of stems for each species. However, the height value for spruce would not be accurate because it did not account for the relative amount of each age class (1000 young stems and 300 older, taller stems). To get the correct answer the surveyor, in estimating average height, would have to weight one age class more than the other as follows: (1000/1600*0.5)+(300/1600*2.9) = 0.9m.*

REMOVING AREAS FROM THE POPULATION

Circumstances may arise that require the removal of a block or a portion of a block from a population. This could be because of an unforeseeable event, such as fire or pest infestation (or other catastrophic occurrence), not precipitated by activities of the licensee, or it could be because a licensee wants to evaluate the area under a different standard. In the later case, this would need to be enabled in an approved FSP. In either case, if the removal was approved before the 13 year assessment date, there would be no consequence in terms of the compilation procedure. If, however, the area were removed after the 13 year assessment, a recompilation of the population PMV and TMV could be required. The process for doing this would be identical to that described in the sections on PMV and TMV compilation, except that the plots corresponding to the areas that are removed would not be included in the compilation. It is **not** recommended that the original plot data be adjusted to reflect the time that has elapsed since the original assessment.

TRACKING AND REPORTING

Required Information

Activity records must be kept to support management decisions, to demonstrate that legal obligations have been fulfilled, and to provide the information needed to meet government reporting obligations (see text box below). Tracking and reporting requirements in the multi-block system include:

- ***Harvest commencement date*** – because regeneration and free growing late dates (7 and 20 years respectively) are tracked from harvest commencement.
- ***Harvest completion date*** – because the population that is used for the multi-block regeneration performance standard is defined by harvest completion date.
- ***The standard's unit*** pertaining to each area harvested – because, by regulation, a map must be submitted showing standards units and the standards that apply to them whenever an area is harvested.
- ***The type and dates of all silviculture activities*** that have been completed – because the completion dates trigger timelines for surveys and affect other planning.
- ***A description of all silviculture activities*** that have taken place (usually in the form of data such as number of trees, species, seedlot, etc.) The section on Data Acquisition – Plot Data summarizes the type of data that is required to determine whether the multi-block regeneration standard has been met.
- ***A map of the area affected by treatment activities*** together with the descriptive information noted above by administrative unit, block, stratum and/or standards unit.
- ***A forest cover inventory*** (including a map of forest cover polygons) for areas that have been harvested, areas declared to be regenerated, and areas declared to be free growing.
- ***The location and condition of any underperforming areas***.
- ***Whether a regeneration declaration has been made*** for any area regenerated.
- ***Whether a free growing declaration has been made*** for any area regenerated.
- ***Whether Government reporting requirements have been met***.

Government Reporting Requirements

- For each area in which timber harvesting was completed in the period April 1st to Mar. 31st, a map must be submitted showing standards units and the standards that apply to them.
- When a stand has been declared to be regenerated or free growing, an update of the forest cover inventory for the area must be submitted.
- A declaration that an area is regenerated or free growing must be made by June 1st for the 12 month period beginning on April 1 of the preceding year.
- Declarations can be made any time after the applicable stocking standards are met as long as the declaration doesn't exceed the "late date".

Data Management Systems

Each licensee will have their own internal data management system (e.g. Genus) with associated file structure, data entry protocol, and metadata. Much of the information needed to make management decisions or to assess the results of treatment activities will be contained there. This User's Manual, does not address the use of these systems to record the information described above. Each Licensee will need to produce their own protocol to record the necessary information in their data management system. How *Results* is used to record and report multi-block information, however, is briefly summarized below.

RESULTS

Results (Reporting Silviculture Updates and Land status Tracking System) is an on-line electronic submission tool used to track silviculture activities

and is part of the MoF Electronic Submission Framework (see http://www.for.gov.bc.ca/his/results/index.htm). Data submitted in *Results* is explicitly linked to associated spatial information. It allows Licensees to submit and amend their stocking standards, report silviculture activities, track stocking obligations, submit maps showing land status, make declarations about regeneration and free growing status, and extract various reports. On-line tutorials are available as well as the Results Information Submission Specifications (ver 3a, Oct. 2008) Guide available at http://www.for.gov.bc.ca/dck/lim/RISS_ls_3a_ed_Oct1.pdf.

In *Results*, data submission is accomplished by clicking on the Data Submission tab to link to the ESF website or by going directly to the ESF portal. Virtually all new data is uploaded into the ESF website with xml (extensible markup language) and gml (geographic markup language) files. Once a stocking standard has been submitted (under Openings/Stocking Standards) and approved, there are five reporting functions that are used to track activities and the status of harvested areas:

- the opening definition report
- the disturbance report
- the silviculture activity report
- the forest cover inventory report
- the milestone declaration report

Stage in Lifecycle:	**Harvest**	**Planting**	**Regeneration Survey(s)**	**Silviculture Treatments** (e.g., brushing, spacing, pruning)	**Free-growing Surveys**
	Year 0 →				**Year 20**
Report Type:	***Opening Definition*** [FPPR 87]; ***Disturbance*** [FPPR 86(3)(a), 86(5)]; ***Forest Cover*** [FPPR 86(3)(a), 86(5)]	***Silviculture Activity*** [FPPR 86(3)(c), 86(5)]	***Forest Cover*** [FPPR 86(3)(d), 86(5)]; ***Milestone Declaration*** [FPPR 97]	***Silviculture Activity*** [FPPR 86(3)(e), 86(5)]	***Forest Cover*** [FPPR 86(3)(d), 86(5)]; ***Milestone Declaration*** [FPPR 97]

Generalized life cycle of an opening and related e-submissions and legislation (source: Results Information Submission Specifications, 2008).

The multi-block regeneration performance system relates directly to three of these reports:

- The silviculture activity report: which includes information on the type of treatment, objectives, funding source, and area treated.
- The forest cover inventory report: which includes forest cover inventory attribute data (e.g. area, number of trees, tree species, tree species percent, age, height, site index, etc.) and spatial data (e.g. geographic location, shape of the polygon, etc.) for each polygon in an opening.
- The milestone declaration report: used to declare that harvesting has been completed, a harvested area has been regenerated, or that a harvested area has achieved free growing status. Milestone declarations are submitted individually for each standards unit in an opening. Note that milestone declarations are optional and can be submitted any time after the applicable stocking standards have been met.

Detail on how each field in each of the reports is filled out can be found in the Results Information Submission Specifications Guide, Oct. 2008. Because the system was not developed with a multi-block standard in mind, there are a number of issues that arise when entering multi-block information. The most pertinent of these are described below:

- Much of the information entered in *Results* relates to standards units. While data can be entered by standards unit (essentially equivalent to a soil disturbance unit) this level of detail is not meaningful in the multi-block system. More useful information is produced when data is summarized by stratum (species, site index, and stocking class), like it is in the Multi-Block compiler, and archived in a Licensees internal data management system.
- During the electronic submission of the multi-block stocking standard there will be a number of fields that are not completed: Well Spaced Trees/Ha (and associated targets and minimums), Residual Basal Area, Post Spacing Density, Height Relative to Comp, and the Preferred and Acceptable Species fields. None of these measures of performance are applicable in the multi-block system.
- There is no place to adequately list which tree species are suitable by site series when submitting a multi-block standard. The best that can be done is to simply list the acceptable tree species under the Acceptable Species tab.
- There is no place to enter detail on predicted future volume or other measures of performance used in the multi-block system.
- In the Forest Cover Inventory Report: the Forest Cover Silviculture Component information will not be filled out because information on Total Well Spaced, Well Spaced, Free Growing, and Basal area is not applicable and other data is already captured under the Inventory Component.

In summary, there are a number of fields in *Results* that will not normally be populated when a multi-block standard is being used. Other submissions in *Results*, such as milestone declarations, are not as problematic. When making a regeneration declaration, for example, the user will continue to click the Milestones tab, fill out the declaration date, provide a written declaration in the comments dialogue box, fill out the associated activity report, and prepare a forest cover inventory report. The lack of information in other types of submissions, however, could potentially cause RESULTS to reject them because they are not configured according to required schema, or because errors are identified during the system's validation checks. In such a case Caroline MacLeod (MoF, Forest Practices Branch) should be contacted at 250-356-2094 (caroline.macleod@gov.bc.ca) to help develop a solution. It is expected that ESF and *Results* will eventually be modified to better reflect legal requirements and information needs associated with a multi-block standard.

Example of a free growing declaration in *Results.*

If there are any questions regarding any aspect of this User's Manual or the associated compiler, please contact:

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or

Larry McCulloch
250-847-3267
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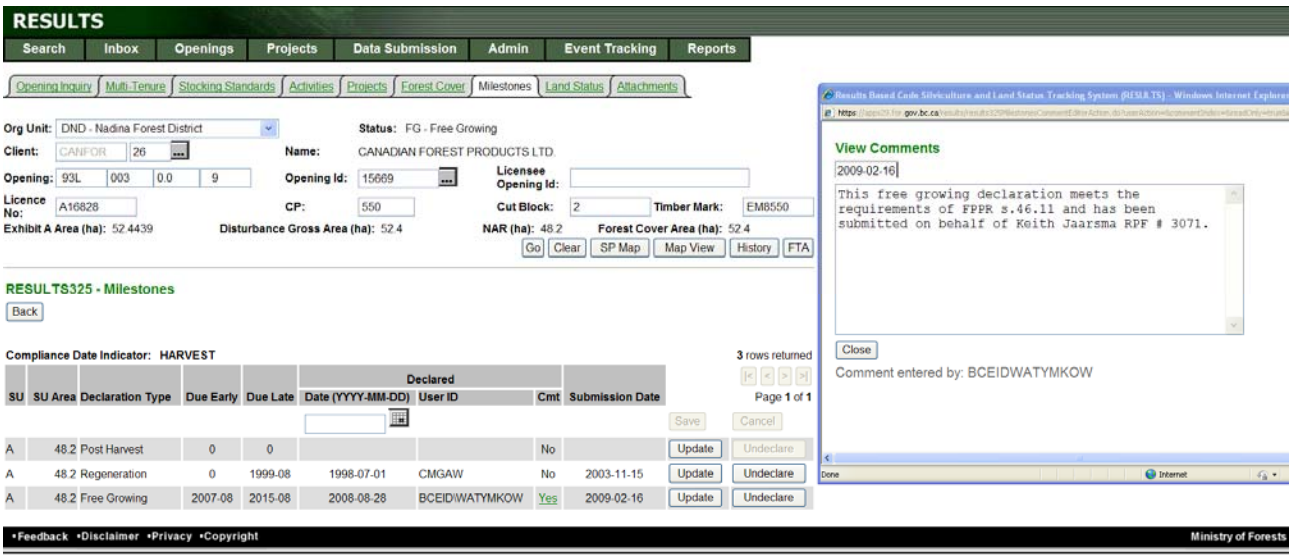

APPENDIX I – TREE SPECIES SELECTION TABLE

		Ecologically Suitable and Economically Valuable Tree Species (S)										
		Coniferous								Broadleaf		
Zone, Subzone and Variant	**Site Series**	**Pl**	**Fd**	**Sx**	**Sb**	**Bl**	**Hm**	**Ba**	**Lw**	**Act**	**At**	**EP**
ESSFmc	01	S		S		S						
ESSFmc	02	S		S		S						
ESSFmc	03	S		S		S						
ESSFmc	04	S		S		S						
ESSFmc	05	S		S		S						
ESSFmc	06	S		S		S						
ESSFmc	07	S		S		S						
ESSFmc	08			S		S						
ESSFmc	09			S		S						
ESSFmc	10			S		S						
ESSFmk	01	S		S		S	S	S				
ESSFmk	02	S		S		S	S					
ESSFmk	03	S		S		S	S	S				
ESSFmk	04	S		S		S	S	S				
ESSFmk	05	S		S		S	S	S				
ESSFmk	06			S		S	S	S				
ESSFmk	07			S		S		S				
ESSFmv3	01	S		S		S						
ESSFmv3	02	S		S		S						
ESSFmv3	03	S		S	S	S						
ESSFmv3	04	S		S		S						
ESSFmv3	05	S		S		S						
ESSFmv3	06	S		S		S						
ESSFmv3	07	S		S		S						
SBSdk	01	S	S	S					S		S	S
SBSdk	02	S	S	S							S	S
SBSdk	03	S	S	S	S						S	
SBSdk	04	S	S	S					S		S	S
SBSdk	05	S	S	S							S	S
SBSdk	06	S	S	S					S	S	S	S
SBSdk	07	S		S						S	S	S
SBSdk	08	S		S						S	S	S
SBSdk	09	S		S	S							
SBSdk	10	S		S	S							
SBSmc2	01	S	S[1]	S		S					S	
SBSmc2	02	S	S[1]	S		S					S	
SBSmc2	03	S		S	S	S					S	

		Ecologically Suitable and Economically Valuable Tree Species (S)										
		Coniferous								Broadleaf		
Zone, Subzone and Variant	Site Series	Pl	Fd	Sx	Sb	Bl	Hm	Ba	Lw	Act	At	EP
SBSmc2	05	S		S		S				S	S	
SBSmc2	06	S		S		S				S	S	
SBSmc2	07	S		S	S	S					S	
SBSmc2	08	S		S		S				S	S	
SBSmc2	09	S		S		S				S	S	
SBSmc2	10	S		S		S				S	S	
SBSmc2	12	S		S	S	S						
SBSwk3	01	S		S		S				S	S	S
SBSwk3	02	S	S	S		S						
SBSwk3	03	S	S	S					S		S	S
SBSwk3	04	S	S	S		S			S		S	S
SBSwk3	05	S		S	S						S	
SBSwk3	06	S		S		S				S	S	S
SBSwk3	07	S		S		S				S	S	S
SBSwk3	08	S		S		S				S	S	

Footnote 1. Warm, southern exposures only.

"S" = suitable, "Ba" = amabilis fir, "Bl" = subalpine fir; "Fd" = Douglas-fir; "Lw" = western larch; "Hm" = mountain hemlock; "Pl" = lodgepole pine; "Sb" = black spruce; "Sx" = hybrid spruce or interior spruce; "Act" = black cottonwood; "At" = trembling aspen; "Ep" = common paper birch;

APPENDIX II – EFFECTIVE AGE CURVE DERIVATION

Effective age tables were produced for interior hybrid spruce, lodgepole pine, subalpine fir, interior Douglas-fir, interior western hemlock, aspen, birch, and cottonwood. In the compilation program, balsam species is assumed to be equivalent to spruce, and birch is assumed to be equivalent to aspen although separate tables have been produced for them. No table has been produced for western larch but it is assumed to be equivalent to Douglas-fir. Information for the tables was produced from Site Tools, ver 3.3, Sept. 29th, 2004 using the yield equations indicated below. Any interpolations necessary to support the resolution of the plot data, were straight line linear.

For Spruce:
Nigh, G.D. and B.A. Love. 2000. Juvenile height development in interior spruce stands of British Columbia. West. J. Appl. For. 15: 117-121. Goudie, J.W. 1984. Height growth and site index curves for lodgepole pine and white spruce and interim managed stand yield tables for lodgepole pine in British Columbia. B.C. Min. For., Res. Br. Unpubl. Rep. 75 p. Note that these curves resulted from splicing the juvenile height curves by Nigh and Love (2000) to the height-age curves by Goudie (1984).

For Pine:
Nigh 1999: Smoothing top height estimates from two lodgepole pine height models. B.C. Min. For., Res. Br., Victoria, B.C. Ext. Note 30. The Thrower (1994 – see below) and Nigh and Love (1999 – see below) Pl curves are spliced together by using the Nigh/Love curve below breast height age 0, the Thrower curve above breast height 2, and linearly interpolating heights between breast height age 0 and 2.

Nigh, G.D. and B.A. Love. 1999. A model for estimating juvenile height of lodgepole pine. For. Ecol. Manage. 123: 157-166. The juvenile height-age model was developed from 46 stem analysis plots ranging from 12 to 24 years (total age) and 19 to 23 m in site index established in the Bulkley valley. Because this model was specifically designed to estimate juvenile height growth from germination up to a total age of 15 years, other curves were needed to cover site index and height conditions outside the range for this model (noted below).

J.S. Thrower and Associates Ltd. 1994. Revised height-age curves for lodgepole pine and interior spruce in British Columbia. Report to the Res. Br., B.C. Min. For., Victoria, B.C. 27 p. The height-age model was developed from 106 plots established throughout the interior of British Columbia. Ages ranged from 50 to 130 years at breast height. The site indices of the plots ranged from 6 to 27 m at breast height age 50. A years to breast height model was also developed.

For Douglas-fir:
Thrower, James S. and James W. Goudie. 1992. Estimating dominant height and site index for even-aged interior Douglas-fir in British Columbia. West. J. Appl. For. 7(1):20-25.

For Hemlock:
Nigh, G. D. 1998. A system for estimating height and site index of western hemlock in the interior of British Columbia. For. Chron. 74(4): 588-596.

For Aspen:
Nigh, G.D., P.V. Krestov, and K. Klinka. 2002. Trembling aspen height-age models for British Columbia. Northwest Sci. Vol. 36, No. 3.

For Cottonwood:
J. S. Thrower and Associates Ltd. 1992. Height-age/site-index curves for Black Cottonwood in British Columbia. Ministry of Forests, Inventory Branch. Project 92-07-IB, 21p